USDA
NATURAL RESOURCES
CONSERVATION SERVICE

DELAWARE CONSERVATION
PRACTICE STANDARD

COVER CROP

CODE 340

DEFINITION

Crops including grasses, legumes and forbs for seasonal cover and other conservation purposes.

PURPOSES

1. Reduce erosion from wind and water.
2. Increase soil organic matter content.
3. Capture and recycle or distribute nutrients in the soil profile.
4. Promote biological nitrogen fixation.
5. Increase biodiversity.
6. Weed suppression.
7. Provide supplemental forage.
8. Soil moisture management.
9. Reduce particulate emissions into the atmosphere.
10. Minimize and reduce soil compaction

CONDITIONS WHERE PRACTICE APPLIES

On all lands requiring vegetative cover for natural resource protection and or improvement.

CONSIDERATIONS

Plant cover crop in a timely matter to establish a good stand.

The right time to kill the cover crop will depend on the specific rotation, weather and objectives. Consider allowing time to prepare the field for the next crop and avoiding excess moisture depletion by the cover crop. When faster mineralization of nutrients tied up in the cover crop's biomass is desired, consider destroying in the vegetative state when carbon/nitrogen ratios are lower. When weed suppression and increasing organic matter is a goal, consider killing the cover crop in the early reproductive stage, when carbon/nitrogen ratios are higher.

Use deep-rooted species to maximize nutrient recovery.

Use grasses to utilize more soil nitrogen, and legumes utilize both nitrogen and phosphorus.

Avoid cover crop species that harbor or carryover potentially damaging diseases or insects.

For most purposes for which cover crops are established, the combined canopy and surface cover is at nearly 90 percent or greater, and the above ground (dry weight) biomass production is at least 4,000 lbs/acre.

Cover crops may be used to improve site conditions for establishment of perennial species.

Use plant species that enhance bio fuels opportunities.

Use plant species that enhance forage opportunities for pollinators.

CRITERIA

Criteria Applicable to All Purposes

Plant species, seedbed preparation, seedling rates, seeding dates, seeding depths, fertility requirements, and planting methods will be consistent with approved local criteria and site conditions.

Drilling or planting with a cultipacker-seeder or no-till drill are preferred seeding methods

because they optimize seed-soil contact. Other methods may be used, such as broadcasting seed by hand, cyclone seeder, or aerial, but these methods usually result in poorer seed distribution and germination, and require higher seeding rates to compensate and provide good coverage. Plant cover crops as early as feasible within the time period indicated in Table 1.

Apply lime and fertilizer only if needed based on recent soil test results. Any use of plant nutrients must be in compliance with Delaware nutrient management regulations, as applicable. Commercial nitrogen or phosphorus and/or manures shall not be applied in the fall when one of the purposes is to capture excess nutrients in the soil profile.

The species selected will be compatible with other components of the cropping system.

Cover crops will be terminated by harvest, frost, mowing, tillage, crimping, and/or herbicides in preparation for the following crop.

Herbicides used with cover crops will be compatible with the following crop.

Avoid using plants that are on the state's noxious weed or invasive species lists.

Cover crop residue will not be burned.

Note: Specific cost-sharing programs or other funding sources may dictate criteria in addition to, or more restrictive than, those specified in this standard.

Additional Criteria to Reduce Erosion from Wind and Water

Cover crop establishment, in conjunction with other practices, will be timed so that the soil will be adequately protected during the critical erosion period(s).

Plants selected for cover crops will have the physical characteristics necessary to provide adequate protection.

The amount of surface and/or canopy cover needed from the cover crop shall be determined using the current erosion prediction technology.

Additional Criteria to Increase Soil Organic Matter Content

Cover crop species will be selected on the basis of producing high volumes of organic material and or root mass to maintain or improve soil organic matter.

The NRCS Soil Conditioning Index (SCI) procedure will be used to determine the amount of biomass required to have a positive trend in the soil organic matter subfactor.

The cover crop will be terminated as late as feasible to maximize plant biomass production.

Additional Criteria to Capture and Recycle Excess Nutrients in the Soil Profile

Cover crops will be established and actively growing before the expected period(s) of nutrient leaching. No fall application of commercial fertilizers (N and P) or manure is allowed prior to planting the cover crop. No winter application of commercial fertilizer or manure is allowed. Spring application of manure can resume after March 1st in Sussex County and March 15th in Kent and New Castle Counties. Cover crops cannot be destroyed until after March 15th.

Cover crop species will be selected for their ability to take up large amounts of nutrients from the rooting profile of the soil.

When used to redistribute nutrients from deeper in the profile up to the surface layer, the cover crop will be killed in relation to the planting date of the following crop. If the objective is to best synchronize the use of cover crop as a green manure to cycle nutrients, factors such as the carbon/nitrogen ratios may be considered to kill early and have a faster mineralization of nutrients to match release of nutrient with uptake by following cash crop. A late kill may be used if the objectives are to use as a biocontrol and maximize the addition of organic matter. The right moment to kill the cover crop will depend on the specific rotation, weather and objectives.

Additional Criteria to Promote Biological Nitrogen Fixation.

Only legumes or legume-grass mixtures will be established as cover crops.

The specific Rhizobium bacteria for the selected legume will either be present in the soil or the seed will be inoculated at the time of planting.

Legumes shall be killed as late as feasible to maximize nitrogen fixation.

Credit for nitrogen contributions shall be accounted for in the nutrient management plan.

Additional Criteria to Increase Biodiversity

Cover crop species shall be selected that have different maturity dates, attract beneficial insects, increase soil biological diversity, serve as a trap crop for damaging insects, and/or provide food and cover for wildlife habitat management.

Additional Criteria for Weed Suppression

Species for the cover crop will be selected for their chemical or physical characteristics to suppress or compete with weeds.

Cover crops residues will be left on the soil surface to maximize alleopathic (chemical) and mulching (physical) effects.

For long-term weed suppression, reseeding annuals and/or biennial species can be used.

Additional Criteria to Provide Supplemental Forage

Species selected will have desired forage traits, be palatable to livestock, and not interfere with the production of the subsequent crop.

Forage provided by the cover crop may be hayed or grazed as long as sufficient biomass is let for resource protection.

Additional Criteria for Soil Moisture Management

Terminate growth of the cover crop sufficiently early to conserve soil moisture for the subsequent crop. Cover crops established for moisture conservation shall be left on the soil surface.

In areas of potential excess soil moisture, allow the cover crop to grow as long as possible to maximize soil moisture removal.

Additional Criteria to reduce Particulate Emissions into the Atmosphere

Manage cover crops and their residues so that at least 80& ground cover is maintained during planting operations for the following crop.

Additional Criteria to Minimize and reduce Soil Compaction

Select and manage cover crop species that will produce deep roots and large amounts of surface or root biomass to increase soil organic mater, improve soil structure and increase soil moisture through better infiltration.

PLANS AND SPECIFICATIONS

Plans and specifications for this practice shall be prepared in accordance with the previously listed criteria. Plans and specifications shall contain sufficient detail to ensure successful implementation of this practice. Documentation shall be in accordance with the section "Supporting Data and Documentation" in this standard.

OPERATION AND MAINTENANCE

The producer/client is responsible for the operation and maintenance of the practice.

Control growth of the cover crop to reduce competition from volunteer plants and shading.

Control weeds in cover crops by mowing or by using other pest management techniques.

Control soil moisture depletion by selecting water efficient plant species and terminating the cover crop before excessive transpiration.

Record Keeping

Participating producer must maintain records to allow the certifying individual to document plan implementation. As applicable, records include:

1. Species or species of plants planted.

2. Seeding rates.

3. Recommended seeding dates.

4. Establishment method (i.e. aerial, no-till drill)

5. Planned dates for destroying cover crop.

6. Other information pertinent to establishing and managing the cover crop.

SUPPORTING DATA AND DOCUMENTATION.

The following is a list of the minimum data and documentation to be recorded in the case file:

1. Location of the practice on the conservation map.

2. Assistance notes. The notes shall include dates of site visits, name or initials of the person who made the visit, specifics as to alternatives discussed, decisions made, and by whom.

3. Completed copy of the appropriate job sheet (s) or other specifications, and management plans. Specify the following for each field or groups of fields:

    a. Purpose of the planting.

    b. Soil loss calculation when erosion is a purpose.

    c. Plant species, varieties, method and rate of planting, and planting dates: Refer to Table 1.

    d. Planned rates and timing of nutrient application.

    e. Kill/destroy methods and dates.

    f. Other management requirements, as appropriate.

REFERENCES

1. Bowman, G., C. Cramer, and C. Shirley. A. Clark (ed.). 1998. Managing Cover Crops Profitably. 2nd ed. Sustainable Agriculture Network Handbook Series: Bk 3. National Agriculture Library. Beltsville, MD.

2. Hargrove, W.L., ed. Cover Crops for Clean Water. SWCS, 1991.

3. Magdoff, F. and H. Van Es. Cover Crops. 2000. p. 87-96 In Building Soils for Better Crops. 2nd ed. Sustainable Agriculture Network Handbook Series: bk4. National Agriculture Library. Beltsville, MD.

4. Reeves, D.W. 1994. Cover Crops and Erosion. P. 125-172 In J.L. Hatfield and B.A. Stewart (eds) Crops Residue Management. CRC Press, Boca Raton, FL.

Species	Seeding Rate (lbs/ac) [1/]	Seeding Depth (inches) [2/]	Suitable Uses [3/]							Planting dates based on PHZ		Kill /Suppression Dates
			E	O	R	N	B	F	W	6b	7a-b	
WINTER ANNUAL GRASSES												
Annual Ryegrass *Lolium perenne* spp. *multiflorum*	20 (15-50)	0.25 - 0.5	●	●	●			●	●	9/1 – 10/1	9/1 – 10/20	No later than May 1 for moisture conservation
Spring Oats *Avena sativa*	95 (60-125)	1.0 - 1.5	●	●	●			●	●	9/1 – 10/1	8/1 – 9/15	No later than May 1 for moisture conservation. Spring Oats may winter kill
Winter Barley *Hordeum vulgare*	120 (90-150)	1.0 - 1.5	●	●	●			●	●	9/1 – 10/1	9/1 – 10/15	No later than April 15 for moisture conservation
Winter Rye *Secale cereale*	120 (90-150)	1.0 - 1.5	●	●	●			●	●	9/1 – 10/1	9/1 – 10/20	
Winter Wheat *Triticum aestivum*	120 (90-150)	1.0 - 1.5	●	●	●			●	●	9/1 – 10/1	9/1 – 10/15	
Triticale	105 (90-120)	1.0 – 1.5	●	●	●			●	●	9/1 – 10/1	9/1 – 10/1	No later than April 15 for moisture conservation
WINTER ANNUAL LEGUMES												
Austrian Winter Pea *Pisum sativum*	80 (60-100)	1.0 - 1.5	●			●				8/20 - 10/1	9/1 – 10/15	No later than 1 to 2 weeks before planting the next crop.
Bigflower Vetch *Vicia grandiflora*	35 (25-40)	0.5 - 1.0	●			●				8/20 - 10/1	9/1 – 10/15	
Common Vetch *Vicia sativa*	60 (25-90)	0.5 - 1.0	●			●				8/20 - 10/1	9/1 – 10/15	
Hairy Vetch *Vicia villosa*	20 (15-25)	0.5 - 1.0	●			●				8/20 - 10/1	9/1 – 10/15	
Crimson Clover *Trifolium incarnatum*	15 (10-20)	0.25 - 0.5	●			●				8/20 - 10/1	9/1 – 10/15	
Subterranean Clover *Trifolium subterraneum*	20 (15-30)	0.25 - 0.5	●			●				8/20 - 10/1	9/1 – 10/15	

Species	Seeding Rate (lbs/ac) [1/]	Seeding Depth (inches) [2/]	Suitable Uses [3/]							Planting Dates by PHZ		Kill/Suppression Dates [5/]
			E	O	R	N	B	F	W	6b	7	
WINTER ANNUAL LEGUME/GRASS MIXTURES												
Hairy Vetch **AND ADD:** Rye, Wheat, or Barley	18 (15-20) 45 (40-50)	1.0 1.0	●			●	●	●	●	8/20 - 10/1	9/1 – 10/15	No earlier than May 1 if nitrogen fixation is a goal.
				●	●		●	●	●			
Austrian Winter Pea **AND ADD:** Rye, Wheat, or Barley	60 (50-60) 45 (40-50)	1.0 - 1.5 1.0 - 1.5	●			●	●	●	●	8/20 – 10/1	9/1 – 10/15	
				●	●		●	●	●			
Crimson Clover **AND ADD:** Rye, Wheat, or Barley	15 (13-20) 45 (40-50)	0.5 0.5	●			●	●	●	●	8/20 – 10/1	9/1 – 10/15	
				●	●		●	●	●			
Crimson Clover **AND ADD:**	15 (13-20)	0.5	●			●	●	●	●	8/20 – 10/1	9/1 – 10/15	
Triticale	75 (60-90)	0.5	●	●	●		●	●	●			
SUMMER ANNUALS												
Sudangrass *Sorgham bicolar*	30 (20-40)	0.5 – 1.0	●	●	●			●	●	5/15 – 7/1	5/1 – 6/20	
Sorgham X Sudangrass *Hybrids* *Sorghum bicolor*	25 (20-30)	0.5 – 1.0	●	●	●			●	●	5/15 – 7/1	5/1 – 6/20	
Pearl Millet Pennisetum glaucium	20 (15-20)	0.5 – 1.0	●	●	●			●	●	6/1 -7/15	5/15 – 7/1	
Foxtail (German) Millet Setaria italica	25 (20-30)	0.5 -1.0	●	●	●			●	●	6/1 – 7/15	5/15 -7/1	
Teff Eragrostis tef	5 (4-6)	0.125– 0.25	●	●	●			●	●			

WINTER ANNUAL BRASSICAS												
Kale Brassica oleracea	8 (5-12)	0.25 – 0.5	●		●			●	●	8/1 – 9/15	8/1 – 9/15	May be used for grazing animals. Kill prior to seed heads maturing
Winter Rape (or Canola)	8 (5-12)	0.25 – 0.5	●		●			●	●	8/1 – 9/15	8/1 – 9/15	May be used for grazing animals Kill prior to seed heads maturing

NOTES FOR TABLE 1:

1. **Seeding Rate:** The primary seeding rate should be used if broadcast seeding and cultipacking with average seedbed conditions. A seeding range is also given, in parentheses. When an optimum seedbed can be prepared or when a drill is used, use the rate at the low end of the range. When broadcast seeding without cultipacking, planting later than the ideal period, or planting in a rough seedbed, use the rate at the high end of the range. If aerial seeding, increase the seeding rate by 50%.

2. **Seeding Depth:** Provides the recommended depth to plant seed to obtain the best germination. Plant deeper in sandy soil, and less deep on clayey soil.

3. **Suitable Uses:** Lists the benefits obtained from each species or mix:
   E - Erosion control, wind and water
   O – Organic matter added
   R – Recycle excess nutrients
   N – Nitrogen Fixation
   B - Biodiversity
   F – Forage
   W -Weed suppression.

4. **Planting Dates:** Preferred planting dates are listed based on the Plant Hardiness Zones

5. **Kill/Suppression Dates:** The preferred timing for killing the cover crop or suppressing growth of the crop. Harvesting or herbicide treatment may be used, or the crop may be plowed under, depending on the purpose and desired use of the cover crop.

6. **"Brassica" cover crops** (family *Brassicaceae*) include rape, kale, mustard, turnips, etc. Canola is a term for rape cultivars that are used to produce oil and other products for human and livestock consumption. All rape varieties are suitable for use as cover crops.

   Brassicas can be especially useful for planting after early vegetable crops. Brassica cover crops are well-suited for uptake of residual nitrogen in the fall because they grow rapidly during periods of cool weather. They may also provide other benefits such as suppression of detrimental nematodes, plant diseases, and weeds.

There are a few drawbacks to using Brassica cover crops: (1) Brassicas have low tolerance for poorly drained or frequently flooded soils;
(2) Plants are susceptible to below freezing temperatures, and may winter-kill. It is important that they be well-established (6 to 8 leaf stage) before a hard freeze in order to provide the benefits of a cover crop; (3) If allowed to set seed, these plants may become "weedy" in crop fields